EXHIBIT R

[redacted]

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

TQ DELTA, LLC, *Plaintiff*, v. COMMSCOPE HOLDING COMPANY, INC., COMMSCOPE, INC., ARRIS US HOLDINGS, INC., ARRIS SOLUTIONS, INC., ARRIS TECHNOLOGY, INC., and ARRIS ENTERPRISES, LLC, *Defendants*.	Civil Action No.: 2:21-cv-310 [redacted]

RESPONSIVE EXPERT REPORT OF DR. NAOFAL AL-DHAHIR
REGARDING FAMILY 10

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meaning of the claims based on the perspective of one of skill in the art and consistent with my experience in the field.

X. ACCUSED PRODUCTS

92. I understand that TQ Delta accuses several CommScope products and different modes of operation, including: CommScope's BGW210 VDSL2, CommScope's BGW210 G.inp-VDSL2 Operation with ROC enabled, CommScope's BGW210 G.inp-VDSL2 Operation with ROC not enabled, CommScope's 5268AC VDSL2 Product Operation, CommScope's 5268AC G.inp-VDSL2 product operation with ROC enabled, and CommScope's 5268AC G.inp-VDSL2 Operation with ROC not enabled (collectively "CommScope Accused Products").

XI. COMMENTS ON TQ DELTA'S EXPERTS' ANALYSIS

93. I noticed a number of errors and inconsistencies in TQ Delta's experts' analyses, which I discuss further below in this section. In Section XIII, I address TQ Delta's experts' analysis of the CommScope Accused Products.

A. Dr. Cooklev's Testing of Certain CommScope Accused Products

94. I have reviewed the methodology outlined by Dr. Cooklev in Section VII.C.6.a)(a) and Exhibit 9 of his report, which he used to test the CommScope Family 10 Accused Products. *See* Cooklev Rpt. at ¶¶ 804-50.

95. In my opinion, as explained in further detail below, Dr. Cooklev's testing methodology was flawed and, as a result, his conclusions are unreliable. Furthermore, Dr. Cooklev's testing does not reflect how CommScope's products are actually configured and operate when deployed. Consequently, Dr. Brody's conclusions are unreliable to the extent that they rely on Dr. Cooklev's test results.

96. As an initial matter, Dr. Cooklev's testing does not show that the ROC mode was even enabled by the Accused Product. As I explain further below, Dr. Cooklev did not capture, or

at least did not include in his report, the contents of initialization messages that would have provided information about the ROC or its use. And the information Dr. Cooklev did provide indicates that the ROC was not enabled.

97. In addition, Dr. Cooklev's testing does not show that, for bit loading during initialization, a first target SNR margin was used on a first plurality of subcarriers and a second, different target SNR margin was used on a second plurality of subcarriers. As I explain further below, Dr. Cooklev did not capture, or at least did not include in his report, the contents of initialization messages that would have provided information about target noise margins that might have been used.

98. Moreover, Dr. Cooklev's testing does not show that (a) the measured or computed SNR margin is the same first SNR margin value for a first plurality of subcarriers, (b) that the measured or computed SNR margin is the same second SNR margin value for a second plurality of subcarriers, and (c) that the first SNR margin value is different from the second SNR margin value. Although claim 10 requires the transceiver to be operable to "receive a first/second plurality of bits on the first/second plurality of carriers using a first/second SNR margin," Dr. Cooklev admits that the margins for different carriers within the same plurality are only "approximately" the same. Cooklev Rpt. at ¶¶ 822, 824.

1. Dr. Cooklev's Tests Do Not Show That the Optional ROC Mode Is Even Used

99. Dr. Cooklev's tests did not capture specific VTU-O messages that specify the use of the ROC and/or retransmission for G.inp. For example, Dr. Cooklev did not capture O-MSG1, which is how the VTU-O would specify TARSNRMds, or O-TPS, which indicates whether the ROC is enabled.

100. Dr. Cooklev's failure to capture O-TPS is fatal because if the ROC is disabled, there

at least did not include in his report, the contents of initialization messages that would have provided information about the ROC or its use. And the information Dr. Cooklev did provide indicates that the ROC was not enabled.

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100. Dr. Cooklev's failure to capture O-TPS is fatal because if the ROC is disabled, there

is no margin offset between two pluralities of carriers. In other words, when the ROC is disabled, the target margin is the same for all subcarriers. *See* COMMSCOPE124393 at COMMSCOPE124458 (G.998.4, § C.1.2 ("If ROC is disabled in O-TPS or is not supported by either the VTU-O or the VTU-R, single latency with ROC mode (see clause 9.1 of [ITU-T G.993.2]) shall be used and the overhead channel shall use the framing parameters as they are derived for the ROC (see framer constraint limitations in Table 12-47 of [ITU-T G.993.2]) with the following configuration: SNRMOFFSET-ROC = 0 dB. . . .")). Thus, Dr. Cooklev has not provided any test result that indicates there even was an SNRMOFFSET-ROC-ds value, much less that its value was greater than 0.

101. Furthermore, Dr. Cooklev did not provide any evidence that the VTU-R sent any message to indicate it even supports the ROC and/or retransmission for G.inp. For example, Dr. Cooklev did not capture R-MSG2, which indicates the VTU-R's ROC and retransmission capabilities, nor did he include in his report any evidence that the values of the ROC descriptor in R-PMS are anything other than zeros. *See* TQD_TX00355628 at TQD_TX00355912-14 (§ 12.3.5.2.2.3 describing the content of R-PMS and stating "If the ROC is not enabled in the downstream direction, the values in the ROC descriptor shall all be set to zero and shall be ignored by the receiver."). For example, although the screen capture associated with R-PMS shown in paragraph 810 of Dr. Cooklev's report has a field "Downstream-ROC-parameters," Dr. Cooklev did not inspect that field, or, if he did, he did not include any information about it in his report. Either way, Dr. Cooklev failed to prove that the ROC was enabled.

102. Accordingly, Dr. Cooklev has not shown through his tests that the CommScope Family 10 Accused Products even support the ROC or retransmission, much less that either was in use during the tests.

103. Support of the ROC is optional in VDSL2. *See, e.g.*, TQD_TX00355628 at TQD_TX00355696-98, TQD_ TX00355707 (G.993.2, §§ 9.1, 9.5.3.1). Nothing in Dr. Cooklev's tests indicates that ROC mode is used or even that the tested VTU-R supports the ROC. It is clear from the source code cited by Dr. Cooklev that the ROC might not be enabled at the VTU-R. *See, e.g.*, Cooklev Rpt. at ¶ 826. Indeed, Dr. Cooklev acknowledges that the ROC is not necessarily enabled. *See id.* at ¶ 825. Yet he either did not capture the O-TPS message, which would have indicated whether the ROC is enabled, or he did capture it but chose not to include the content of the O-TPS message in his report.

2. Dr. Cooklev's Testing Does Not Show the Use of Different Target Margins For Bit Loading Of Different Pluralities of Carriers

104. Although the target SNR margin parameter TARSNRM (in field #2 of O-MSG 1 in Table 12-49 below) can be set at the central office (CO) side to be the same across a plurality of carriers, Dr. Cooklev did not capture this value. G.993.2 states that "Field #2 'Downstream target SNR margin (TARSNRMds)' indicates the target SNR margin of the VTU-R receiver. The definition and use of this parameter shall be the same as for the parameter 'Downstream Target Noise Margin (TARSNRMds)' specified in [ITU-T G.997.1]. The value and format of this parameter shall be the same as that in Field #12 of O-SIGNATURE (see clause 12.3.3.2.1.1)." TQD-TX00355628 at TQD-TX00355890 (Rec. ITU-T G.993.2 (02/2019)). Dr. Cooklev did not capture O-MSG1 at all, and therefore he has provided no evidence of the value of TARSNRMds that was in use in the tests.

Table 12-49 – Description of message O-MSG 1

	Field name	Format
1	Message descriptor	Message code
2	Downstream target SNR margin (TARSNRMds)	2 bytes
3	Downstream minimum SNR margin (MINSNRMds)	2 bytes
4	Downstream maximum SNR margin (MAXSNRMds)	2 bytes
5	RA-MODE	1 byte
6	NTR	1 byte
7	TPS-TC capabilities	see Table 12-50
8	PMS-TC capabilities	see Table 12-52
9	Downstream Rate adaptation downshift SNR margin (RA-DSNRMds)	2 bytes
10	Downstream Rate adaptation downshift time interval (RA-DTIMEds)	2 bytes
11	Downstream Rate adaptation upshift SNR margin (RA-USNRMds)	2 bytes
12	Downstream Rate adaptation upshift time interval (RA-UTIMEds)	2 bytes
13	Support of "Flexible OH frame Type 2" downstream and INM_INPEQ_FORMATds	1 byte
14	SOS Multi-step activation downstream	1 byte
15	SOS Multi-step activation upstream	1 byte
16	MIN-SOS-BR-ds0	2 bytes
17	MIN-SOS-BR-ds1	2 bytes
18	SOS-TIME-ds	1 byte
19	SOS-NTONES-ds	1 byte
20	SOS-CRC-ds	2 bytes
21	MAX-SOS-ds	1 byte
22	SNRMOFFSET-ROC-ds	2 bytes
23	INPMIN-ROC-ds	1 byte
24	ITU- T G.998.4 parameter field	Variable length
25	ITU-T G.993.5 parameter field	Variable length
26	REINIT_TIME_THRESHOLDds	1 byte
27	Time synchronization capability	1 byte

TQD-TX00355628 at TQD-TX00355890 (Rec. ITU-T G.993.2 (02/2019)).

105. Likewise, Dr. Cooklev did not capture an SNRMOFFSET-ROC-ds value that might have been used for bit loading on other carriers.

106. Therefore, Dr. Cooklev's test results do not show that the tested Accused Product was operable to "receive a first plurality of bits on the first plurality of carriers using a first SNR margin" and to "receive a second plurality of bits on the second plurality of carriers using a second SNR margin."

TQD_TX00355628 at TQD_TX00355904 (G.993.2, Table 12-58).

114. I note, too, that the explanation for the discrepancy cannot be that the first 10 carriers also support bits from latency path 1. VDSL2 specifies that "[i]f the ROC is enabled, the bits of buffer L_0 and buffer L_1 shall not share the same subcarrier," (G.993.2, § 10.3.1), which means that the number of bits allocated for latency path 0 when the ROC is enabled must be exactly a multiple of 8, because any additional bits could not be used to carry bits from latency path 1. That Dr. Cooklev's test showed that the number of bits carried by the first 10 tones in was not a multiple of 8 suggests that no ROC was enabled or used during Dr. Cooklev's test.

115. Accordingly, Dr. Cooklev's test results, and his interpretation of those test results, indicate that the ROC was not enabled or used during the tests.

C. Assertions Related to Compliance with G.933.2 (VDSL1) and G.998.4 (G.inp)

116. I disagree with Dr. Brody's opinion that compliance with G.933.2 (VDSL1) and G.998.4 (G.inp) requires use of Claim 10 of the '354 Patent.

117. Claim 10 of the '354 Patent is not essential to G.993.2 (VDSL2) standard or to G.998.4 (G.inp). G.inp is an optional enhancement (not essential for practicing) for VDSL2 and is not a standalone standard. COMMSCOPE124393-COMMSCOPE124518 (Rec. ITU-T G.998.4 (11/2018)). It is my understanding that it is not sufficient to establish infringement by arguing that the device practices the standard if the relevant section of the standard is optional.

118. The VDSL2 standard specifies a mandatory single latency (latency path 0) mode and two other optional modes: (i) a dual latency (latency paths 0 and 1) mode and (ii) a single latency with a robust overhead channel (ROC) mode. In the ROC mode, the ROC uses latency path 0 and data uses latency path 1. Only when the optional single-latency with ROC mode is enabled, can the target signal-to-noise ratio (SNR) margins for the two latency paths (data and ROC) be set to different values.

119. The following excerpt from the VDSL2 standard shows the different wording used (shall versus may) when describing the three modes. "Shall" denotes when something is necessary whereas "may" denotes when something is optional. As shown below, in the standard, the only mode that is required is the single latency mode, which is the only mode that has "shall" language in regard to what VTU supports. TQD-TX00355628 at TQD-TX00355690 (Rec. ITU-T G.993.2 (02/2019)).

9.1 PMS-TC functional model

The PMS-TC functional models are presented in Figure 9-1 applicable to single latency mode and dual latency mode, and Figure 9-2 applicable to single latency with ROC mode. Up to two bearer channels of transmit user data originated by various TPS-TCs, management data originated by the MPS-TC, and NTR data are incoming via the α/β interface in a uniform format, as specified in clause 8.1.2. The incoming user data and the overhead data are multiplexed into one or two latency paths. Each bearer channel is carried over a single latency path (i.e., shall not be split across two latency paths). A Syncbyte is added to each latency path for OH frame alignment.

Three different modes are allowed:

1) Single latency mode: support of one latency path. The VTU shall support this mode. For this mode, latency path #0 shall be enabled.
2) Dual latency mode: support of two latency paths. The VTU may support this mode. For this mode, latency paths #0 and #1 shall be enabled.
3) Single latency with ROC mode: support of a single latency path for data with a second overhead-only latency path. The VTU may support this mode. For this mode, the data shall use latency path#1 and the ROC shall use latency path #0.

TQD-TX00355628 at TQD-TX00355696 (Rec. ITU-T G.993.2 (02/2019)).

120. Single latency versus dual latency versus single latency with ROC are all different as shown by Figures 9-1 and 9-2 in the G.993.2 Standard.

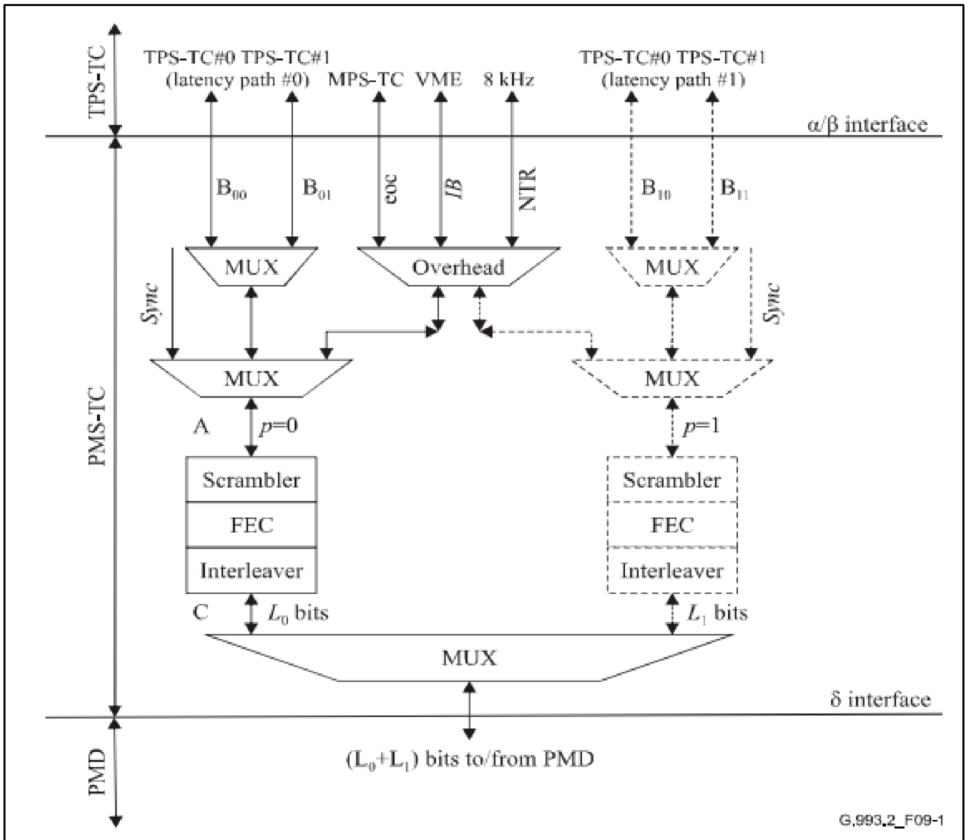


Figure 9-1 – PMS-TC functional model applicable to single latency mode and dual latency mode

TQD-TX00355628 at TQD-TX00355697 (Rec. ITU-T G.993.2 (02/2019)).

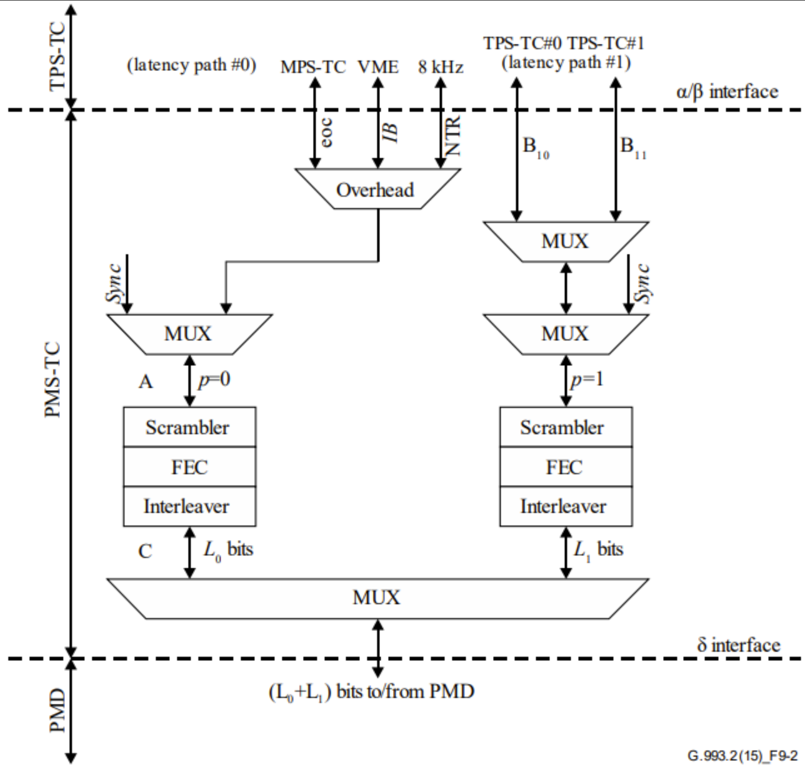


Figure 9-2 – PMS-TC functional model applicable to single latency with ROC mode

TQD-TX00355628 at TQD-TX00355697 (Rec. ITU-T G.993.2 (02/2019)).

121. The following Table 12-53 from the VDSL2 standard describes the O-TPS control message. "The O-TPS message conveys the TPS-TC configuration for both the upstream and the downstream directions. It is based on the capabilities that were indicated in O-MSG 1 and R-MSG 2. The full list of parameters carried by the O-TPS message is shown in Table 12-53." TQD-TX00355628 at TQD-TX00355897 (Rec. ITU-T G.993.2 (02/2019)). Field #4 contains 1 byte (8 bits) and 4 bits of this byte determine whether the ROC mode is enabled or not for the downstream and/or upstream directions of transmission.

Field #4 indicates whether the ROC and SOS are enabled. It is a one byte value [ssss rrrr].

The value rrrr shall be coded as follows:

- A value rrrr=0000 indicates that the ROC is not enabled in either upstream or downstream;
- A value rrrr=0001 indicates that the ROC is enabled in upstream but not in downstream;
- A value rrrr=0010 indicates that the ROC is enabled in downstream but not in upstream;
- A value rrrr=0011 indicates that the ROC is enabled in both upstream and downstream.

The value ssss shall be coded as follows:

- A value ssss=0000 indicates that SOS is not enabled;
- A value ssss=0001 indicates that SOS is enabled in upstream but not in downstream;
- A value ssss=0010 indicates that SOS is enabled in downstream but not in upstream;
- A value ssss=0011 indicates that SOS is enabled in both upstream and downstream.

The value of ssss shall be set in accordance with ITU-T G.997.1 parameters RA-MODEds and RA-MODEus and the OLR capabilities in O-MSG 1 and R-MSG 2.

TQD-TX00355628 at TQD-TX00355898 (Rec. ITU-T G.993.2 (02/2019)).

Table 12-53 – Description of message O-TPS

	Field name	Format
1	Message descriptor	Message code
2	TPS-TC configuration	See Table 12-54
3	Maximum delay variation	See Table 12-55
4	ROC and SOS enable	1 byte
5	ITU-T G.998.4 parameter field	Variable length
6	ITU-T G.993.5 parameter field	Variable length
7	Time synchronization enable	1 byte
8	*attndr_method*	1 byte

TQD-TX00355628 at TQD-TX00355898 (Rec. ITU-T G.993.2 (02/2019)).

122. This clearly shows that enabling the ROC mode is not mandatory in VDSL2 because there is an ability to enable or disable the ROC.

123. Thus, claim 10 of the ’354 Patent is not essential to G.993.2 (VDSL2) standard or to G.998.4 (G.inp) and thus compliance with the standard does not necessarily indicate infringement of Claim 10.

1. “Compliance” with G.993.2 (VDSL2) and G.998.4 (G.inp) Does Not Require Implementation of Every Aspect of the Standard, Exactly as Set Forth

124. In my experience, a product that operates in accordance with, is compliant with, or supports a particular standard does not necessarily implement each of the many hundreds of purportedly mandatory or optional sections of that particular standard exactly as they are specified. *See, e.g.*, TQD-TX00355628 (Rec. ITU-T G.993.2 (02/2019)). (the standard is 442 pages long); *see, e.g.*, COMMSCOPE124393-COMMSCOPE124518 (Rec. ITU-T G.998.4 (11/2018)) (the standard is 126 pages long). Just because a product specification sheet states that a product is "standard compliant," it does not mean that the product implements all aspects of a standard or that it implements portion of the standard in a particular way.

125. The G.993.2 standard itself recognizes that inherent with standard implementation there is flexibility. "This Recommendation defines a wide range of settings for various parameters (such as bandwidth and transmitter power) that could potentially be supported by a transceiver. Therefore, this Recommendation specifies profiles to *allow transceivers to support a subset of the allowed settings and still be compliant with the Recommendation*. The specification of multiple profiles allows vendors to limit implementation complexity and develop implementations that target specific service requirements. Some profiles are better suited for asymmetric data rate services, whereas other profiles are better for symmetric data rate services." TQD-TX00355628 at TQD-TX00355638 (Rec. ITU-T G.993.2 (02/2019)) (emphasis added).

126. The flexibility of the standard allows for products to have different modes that are "standard compliant," but that do not necessarily implement every aspect of the standard or implement the standard in the same exact way as disclosed in the standard. In speaking to testing of the Accused Products, Mr. Miller stated the modems were tested in different modes, including bonded mode or single-line mode and with different VDSL profile settings. Miller Dep. Tr. (07/28/2022) at 46:16-19. Mr. Miller stated it is possible to use different lines, bonded versus

single line when he said "[e]ven bonded versus single line is essentially a . . . DLSAM profile setting or a port setting." Miller Dep. Tr. (07/28/2022) at 47:1-10.

127. It is well known, for example, that the purpose of DSL standards is to ensure that a transceiver made by one manufacturer and connected to one end of a subscriber line will interoperate with a transceiver made by a different manufacturer and connected to the other end of the subscriber line. It is also well known to those having ordinary skill in the art that sometimes a DSL standard will specify a particular way of doing something, but there are other ways of doing it that will be transparent to and undetectable by the transceiver on the other side of the subscriber line. Thus, a transceiver may be fully interoperable but not strictly standard-compliant. [redacted]

XII. SUMMARY OF OPINIONS

128. It is my opinion that BGW210 does not infringe claim 10 of the '354 Patent, because compliance with the VDSL2 and G.inp standards does not necessarily indicate infringement, and the product specifications and hardware, test results, and source code content indicate non-infringement.

129. It is my opinion that 5268AC does not infringe claim 10 of the '354 Patent, because compliance with the VDSL2 and G.inp standards does not necessarily indicate infringement, and

the product specifications and hardware, test results and source code content indicate non-infringement.

XIII. ANALYSIS OF NON-INFRINGEMENT

A. The BGW210 and 5268AC Products In VDSL2 Operation Do Not Infringe Claim 10 of the ’354 Patent.

130. In my opinion, TQ Delta has failed to show that the BGW210 and 5268AC products in VDSL2 operation infringe claim 10 of the ’354 patent for at least the following reasons: (1) Dr. Brody has failed to establish that all elements of claim 10 are satisfied; (2) standard compliance does not necessitate infringement; and (3) Dr. Cooklev’s testing is flawed such that Dr. Brody’s opinions that rely on Dr. Cooklev’s testing are not reliable.

1. Not All Elements of Claim 10 of the ’354 Patent Are Satisfied.

131. In my opinion, TQ Delta’s experts have failed to establish that all elements of claim 10 are satisfied by the BGW210 and 5268AC products in VDSL2 operation.

132. First, it is my opinion that TQ Delta has failed to demonstrate that the limitations of “receive a first plurality of bits on the first plurality of carriers using a first SNR margin” (claim 10.c) and “receive a second plurality of bits on the second plurality of carriers using a second SNR margin” (claim 10.d) are satisfied. To the contrary, the accused product does not use an SNR margin to receive a plurality of bits. As is known in the art, a multicarrier transceiver (like the BGW210 and 5268AC products) can receive and demodulate a plurality of bits from a carrier or plurality of carriers *without knowledge of the SNR margin*. *See, e.g.*, “Fundamentals of DSL Technology,” edited by Philip Golden, Herve Dedieu, and Krista Jacobsen (2015) at 193; *see also, e.g.*, J.A.C. Bingham, “Multicarrier Modulation: An Idea Whose Time Has Come,” IEEE Communications Magazine (May 1990) at 5-14. The transceiver only needs to know the signal constellation size and, for DMT, how the channel attenuates and changes the phase of each

subcarrier in use (all of which is initially determined during initialization and potentially updated during Showtime), but the transceiver does not need to know the target SNR margin assigned to a particular carrier to receive and demodulate that carrier. Furthermore, the transceiver does not need to know or even determine the measured SNR margin (i.e. after bit allocation) of the carrier, which is equal to the difference between the measured receiver SNR on the carrier and the minimum required SNR for a certain signal constellation to achieve a certain bit error rate (e.g., 10^{-7}). *See, e.g.*, *id.* As is well known in the art, and has been well known for decades, a DMT receiver can operate simply by performing analog-to-digital conversion on a received signal, stripping the cyclic extension from each discrete-time symbol and performing a discrete Fourier transform (DFT) on the resulting symbol, performing frequency-domain equalization (FEQ) on the DFT output to (ideally) remove the effects of the channel, and, for each subcarrier in use, determining which constellation point in the applicable constellation diagram is closest to the point output by the FEQ. *See, e.g.*, *id.* There is no consideration or use of any SNR margin during this process. Moreover, the same process is performed regardless of whatever the SNR margin (target or measured) might be.

133. Additionally, the Court's construction for "SNR margin" is "a parameter used in determining the number of bits allocated to each of a plurality of carriers, where the value of the parameter specifies an extra SNR requirement assigned per carrier in addition to the SNR required to maintain a specified bit error rate (BER) for the communication link at a specified bit allocation." Dr. Cooklev's analysis of the Broadcom source code fails to establish that this element is satisfied.

134. In particular, [redacted]

[redacted] In other words, [redacted]

135. It is also my opinion that TQ Delta has failed to establish that the limitation of "wherein the first SNR margin is different than the second SNR margin" (claim 10.f) is satisfied.

136. The VDSL2 standard has three different modes. The VDSL2 standard supports a mandatory single latency (path 0) mode and two other *optional* modes: (i) a dual latency (paths 0 and 1) mode and (ii) a single latency with a robust overhead channel (ROC) mode. In the ROC mode, ROC uses path 0 and data uses path 1. If the single latency with ROC mode is not enabled (i.e. the mandatory single latency path mode or the dual latency path mode is being used) then the SNR margins will not be different from each other. In single latency mode, there is only going to be one SNR margin. If the SNR margins are not different, then the BGW210 and 5268AC products do not meet the claim limitation 10.f, which requires that the SNR margins on the latency paths are different.

137. The following excerpt from the VDSL2 standard shows the different wording used (shall versus may) when describing the three modes. "Shall" denotes when something is necessary whereas "may" denotes when something is optional. As shown below, in the standard, the only mode that is required is the single latency mode, which is the only mode that has "shall" language in regard to what VTU supports. TQD-TX00355628 at TQD-TX00355696 (Rec. ITU-T G.993.2 (02/2019)).

9.1 PMS-TC functional model

The PMS-TC functional models are presented in Figure 9-1 applicable to single latency mode and dual latency mode, and Figure 9-2 applicable to single latency with ROC mode. Up to two bearer channels of transmit user data originated by various TPS-TCs, management data originated by the MPS-TC, and NTR data are incoming via the α/β interface in a uniform format, as specified in clause 8.1.2. The incoming user data and the overhead data are multiplexed into one or two latency paths. Each bearer channel is carried over a single latency path (i.e., shall not be split across two latency paths). A Syncbyte is added to each latency path for OH frame alignment.

Three different modes are allowed:

1) Single latency mode: support of one latency path. The VTU shall support this mode. For this mode, latency path #0 shall be enabled.
2) Dual latency mode: support of two latency paths. The VTU may support this mode. For this mode, latency paths #0 and #1 shall be enabled.
3) Single latency with ROC mode: support of a single latency path for data with a second overhead-only latency path. The VTU may support this mode. For this mode, the data shall use latency path#1 and the ROC shall use latency path #0.

TQD-TX00355628 at TQD-TX00355696 (Rec. ITU-T G.993.2 (02/2019)).

138. If the SNRMOFFSET-ROC value is set to zero such that the margins of the two latency paths are equal, then the first SNR margin is not different than the second SNR margin.

139. Claim 10.g "and wherein the first SNR margin provides more robust reception than the second SNR margin" is not met for the same reasons as claim 10.f. Since the margins on the two latency paths are equal, the first SNR margin would also not provide "more robust reception" than the second SNR margin as required by claim element 10.g.

140. Moreover, in Dr. Cooklev's analysis, he did not consider several different conditional factors and the ability of the code to actually execute code that sends messages. *See generally*, Overby Rpt. [redacted]

[redacted]

2. Standard Compliance Does Not Necessitate Infringement.

141. First, I disagree with Dr. Brody's opinion that standard compliance with G.993.2 (VDSL) necessitates infringement of the '354 Patent by BGW210 and 5268AC.

142. Claim 10 of the '354 Patent is not essential to G.993.2 (VDSL2) standard or to G.998.4 (G.inp). G.inp is an optional enhancement (not essential for practicing) for VDSL2 and is not a standalone standard. *See* COMMSCOPE124393-COMMSCOPE124518 (Rec. ITU-T G.998.4 (11/2018)). It is my understanding that it is not sufficient to establish infringement by arguing that the device practices the standard if the relevant section of the standard is optional.

143. In my experience, a product that operates in accordance with, is compliant with, or supports a particular standard does not necessarily implement each of the many hundreds of purportedly mandatory or optional sections of that particular standard exactly as they are specified. *See, e.g.*, TQD-TX00355628 (Rec. ITU-T G.993.2 (02/2019)). (the standard is 442 pages long); *see, e.g.*, COMMSCOPE124393-COMMSCOPE124518 (Rec. ITU-T G.998.4 (11/2018)) (the standard is 126 pages long). Just because a product specification sheet states that a product is "standard compliant," it does not mean that the product implements all aspects of a standard or that it implements portion of the standard in a particular way.

144. The G.993.2 standard itself recognizes that inherent with standard implementation there is flexibility. "This Recommendation defines a wide range of settings for various parameters (such as bandwidth and transmitter power) that could potentially be supported by a transceiver. Therefore, this Recommendation specifies profiles to *allow transceivers to support a subset of the*

in G-inp-VDSL2 operation with ROC enabled infringe claim 10 of the ’354 patent for at least the following reasons: (1) Dr. Brody has failed to establish that all elements of claim 10 are satisfied; (2) standard compliance does not necessitate infringement; and (3) Dr. Cooklev’s testing is flawed such that Dr. Brody’s opinions that rely on Dr. Cooklev’s testing are not reliable.

155. G-inp is an optional enhancement and is not needed to practice VDSL. It is used in impulse noise enhancement and ROC in this context is used here for an additional margin enhancement against impulse noise.

1. Not All Elements of Claim 10 of the ’354 Patent Are Satisfied.

156. In my opinion, TQ Delta’s experts have failed to establish that all elements of claim 10 are satisfied by the BGW210 and 5268AC products in VDSL2 operation.

157. First, it is my opinion that TQ Delta has failed to demonstrate that the limitations of “receive a first plurality of bits on the first plurality of carriers using a first SNR margin” (claim 10.c) and “receive a second plurality of bits on the second plurality of carriers using a second SNR margin” (claim 10.d) are satisfied. To the contrary, the accused product does not use an SNR margin to receive a plurality of bits. As set forth in VDSL2, a multicarrier transceiver (like the BGW210 and 5286AC products) can receive and demodulate a plurality of bits from a carrier or plurality of carriers *without knowledge of the SNR margin*. *See, e.g.*, “Fundamentals of DSL Technology,” edited by Philip Golden, Herve Dedieu, and Krista Jacobsen (2015) at 193; *see also, e.g.*, J.A.C. Bingham, “Multicarrier Modulation: An Idea Whose Time Has Come,” IEEE Communications Magazine (May 1990) at 5-14. The transceiver only needs to know the signal constellation size and, for DMT, how the channel attenuates and changes the phase of each subcarrier in use (all of which is initially determined during initialization and potentially updated during Showtime), but the transceiver does not need to know the target SNR margin assigned to a particular carrier to receive and demodulate that carrier. Furthermore, the transceiver does not

need to know or even determine the measured SNR margin (i.e. after bit allocation) of the carrier, which is equal to the difference between the measured receiver SNR on the carrier and the minimum required SNR for a certain signal constellation to achieve a certain bit error rate (e.g., 10^{-7}). *See, e.g.*, *id.* As is well known in the art, and has been well known for decades, a DMT receiver can operate simply by performing analog-to-digital conversion on a received signal, stripping the cyclic extension from each discrete-time symbol and performing a discrete Fourier transform (DFT) on the resulting symbol, performing frequency-domain equalization (FEQ) on the DFT output to (ideally) remove the effects of the channel, and, for each subcarrier in use, determining which constellation point in the applicable constellation diagram is closest to the point output by the FEQ. *See, e.g., id.* There is no consideration or use of any SNR margin during this process. Moreover, the same process is performed regardless of whatever the SNR margin (target or measured) might be.

158. Additionally, the Court's construction for "SNR margin" is "a parameter used in determining the number of bits allocated to each of a plurality of carriers, where the value of the parameter specifies an extra SNR requirement assigned per carrier in addition to the SNR required to maintain a specified bit error rate (BER) for the communication link at a specified bit allocation." Dr. Cooklev's analysis of the Broadcom source code fails to establish that this element is satisfied.

159. In particular, [redacted]

[redacted]

160. It is also my opinion that TQ Delta has failed to establish that the limitation of "wherein the first SNR margin is different than the second SNR margin" (claim 10.f) is satisfied.

161. The VDSL2 standard has three different modes. The VDSL2 standard supports a mandatory single latency (path 0) mode and two other *optional* modes: (i) a dual latency (paths 0 and 1) mode and (ii) a single latency with a robust overhead channel (ROC) mode.

162. The following excerpt from the VDSL2 standard shows the different wording used (shall versus may) when describing the three modes. "Shall" denotes when something is necessary whereas "may" denotes when something is optional. As shown below, in the standard, the only mode that is required is the single latency mode, which is the only mode that has "shall" language in regard to what VTU supports. TQD-TX00355628 at TQD-TX00355696 (Rec. ITU-T G.993.2 (02/2019)).

9.1 PMS-TC functional model

The PMS-TC functional models are presented in Figure 9-1 applicable to single latency mode and dual latency mode, and Figure 9-2 applicable to single latency with ROC mode. Up to two bearer channels of transmit user data originated by various TPS-TCs, management data originated by the MPS-TC, and NTR data are incoming via the α/β interface in a uniform format, as specified in clause 8.1.2. The incoming user data and the overhead data are multiplexed into one or two latency paths. Each bearer channel is carried over a single latency path (i.e., shall not be split across two latency paths). A Syncbyte is added to each latency path for OH frame alignment.

Three different modes are allowed:

1) Single latency mode: support of one latency path. The VTU shall support this mode. For this mode, latency path #0 shall be enabled.
2) Dual latency mode: support of two latency paths. The VTU may support this mode. For this mode, latency paths #0 and #1 shall be enabled.
3) Single latency with ROC mode: support of a single latency path for data with a second overhead-only latency path. The VTU may support this mode. For this mode, the data shall use latency path#1 and the ROC shall use latency path #0.

TQD-TX00355628 at TQD-TX00355696 (Rec. ITU-T G.993.2 (02/2019)).

163. In the ROC mode, ROC uses path 0 and data uses path 1. Only when the optional single-latency with ROC mode is enabled, can the target signal-to-noise ratio (SNR) margins for the two latency paths (data and ROC) be set to different values. Even when the single latency with ROC mode is enabled, to prove that the two latency paths for data and overhead use different target SNR margins, a non-zero value for the target SNR margin offset parameter, denoted by SNRMOFFSET-ROC, must be shown. Table 12-49 of the VDSL2 standard, shown below, describes the contents of the control message O-MSG 1 where field #22 contains 2 bytes that determine the value of the parameter SNRMOFFSET-ROC.

Table 12-49 – Description of message O-MSG 1

	Field name	Format
1	Message descriptor	Message code
2	Downstream target SNR margin (TARSNRMds)	2 bytes
3	Downstream minimum SNR margin (MINSNRMds)	2 bytes
4	Downstream maximum SNR margin (MAXSNRMds)	2 bytes
5	RA-MODE	1 byte
6	NTR	1 byte
7	TPS-TC capabilities	see Table 12-50
8	PMS-TC capabilities	see Table 12-52
9	Downstream Rate adaptation downshift SNR margin (RA-DSNRMds)	2 bytes
10	Downstream Rate adaptation downshift time interval (RA-DTIMEds)	2 bytes
11	Downstream Rate adaptation upshift SNR margin (RA-USNRMds)	2 bytes
12	Downstream Rate adaptation upshift time interval (RA-UTIMEds)	2 bytes
13	Support of "Flexible OH frame Type 2" downstream and INM_INPEQ_FORMATds	1 byte
14	SOS Multi-step activation downstream	1 byte
15	SOS Multi-step activation upstream	1 byte
16	MIN-SOS-BR-ds0	2 bytes
17	MIN-SOS-BR-ds1	2 bytes
18	SOS-TIME-ds	1 byte
19	SOS-NTONES-ds	1 byte
20	SOS-CRC-ds	2 bytes
21	MAX-SOS-ds	1 byte
22	SNRMOFFSET-ROC-ds	2 bytes
23	INPMIN-ROC-ds	1 byte
24	ITU- T G.998.4 parameter field	Variable length
25	ITU-T G.993.5 parameter field	Variable length
26	REINIT_TIME_THRESHOLDds	1 byte
27	Time synchronization capability	1 byte

TQD-TX00355628 at TQD-TX00355890 (Rec. ITU-T G.993.2 (02/2019)).

> Field #22 contains the value of SNRMOFFSET-ROCds as specified in the MIB. The parameter is defined as the SNR Margin offset for the ROC in the downstream direction. This means that the target margin for the ROC is obtained by adding this value to TARSNRM (i.e., TARSNRM-ROC = TARSNRM + SNRMOFFSET-ROC).
>
> The parameter TARSNRM-ROC is used in the specification of the channel initialization policy (see clause 12.3.7.1).
>
> The value shall be coded as an 16 bit unsigned integer with LSB weight of 0.1 dB. The valid range of values is from 0 to 31 dB with 0.1 dB steps.Field #23 contains the value of INPMIN-ROCds expressed in multiples of T_{4k} as specified in the MIB. The value of INPMIN-ROCds expressed in DMT symbols (as to be used by the VTU-R receiver as specified in clause 9.6), is calculated as follows:
>
> For 4.3125 kHz subcarrier spacing:
>
> INPMIN-ROCds in DMT symbols = INPMIN-ROCds in multiples of T_{4k}.
>
> For 8.625 kHz subcarrier spacing:
>
> INPMIN-ROCds in DMT symbols = 2 × (INPMIN-ROCds in multiples of T_{4k}).
>
> with T_{4k} as defined in clause 10.4.4.
>
> The parameter INPMIN-ROCds (in DMT symbols) is defined as the required INP_no_erasure value for the ROC (see clause 9.6). The value of field #23 is an integer in the range from 0 to 8.
>
> If the CO does not support a robust overhead channel in the downstream direction, the fields #22 and #23 shall contain a value within the specified valid range for each of the parameters. These values shall be ignored at the receiver.

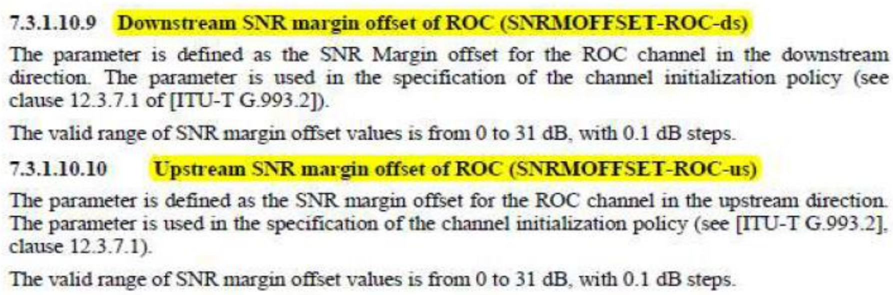
TQD-TX00355628 at TQD-TX00355893 (Rec. ITU-T G.993.2 (02/2019)).

164. Dr. Cooklev in the SNR margin testing section VII.C.6 of his report does not show the contents of O-MSG 1 or the value of the target SNR margin offset between the data and overhead latency paths SNRMOFFSET-ROC. In not showing the value of the target margin offset, Dr. Cooklev has not proven that the values are different such that it meets the claim limitation for 10.f.

165. [redacted]

[redacted]

166. Even if the single latency path with ROC mode is enabled, the value 0 is a valid value for the parameter SNRMOFFSET-ROC at which the target SNR margins for both latency paths are equal. This is shown in the ITU recommendation G.997.1 excerpt below. G.997.1 is the ITU recommendation for the management of VDSL lines.



7.3.1.10.9 Downstream SNR margin offset of ROC (SNRMOFFSET-ROC-ds)

The parameter is defined as the SNR Margin offset for the ROC channel in the downstream direction. The parameter is used in the specification of the channel initialization policy (see clause 12.3.7.1 of [ITU-T G.993.2]).

The valid range of SNR margin offset values is from 0 to 31 dB, with 0.1 dB steps.

7.3.1.10.10 Upstream SNR margin offset of ROC (SNRMOFFSET-ROC-us)

The parameter is defined as the SNR margin offset for the ROC channel in the upstream direction. The parameter is used in the specification of the channel initialization policy (see [ITU-T G.993.2], clause 12.3.7.1).

The valid range of SNR margin offset values is from 0 to 31 dB, with 0.1 dB steps.

Rec. ITU-T G.997.1.

> **12.3.7.1 Channel initialization policies with ROC**
>
> The method used by the receiver to select the values of transceiver parameters described in this clause is implementation dependent. However, within the limit of the total data rate provided by the local PMD, the selected values shall meet all of the constraints communicated by the transmitter prior to the channel analysis and exchange phase, including:
>
> - Message overhead data rate ≥ Minimum message overhead data rate;
> - Net data rate ≥ Minimum net data rate for all bearer channels;
> - Impulse noise protection ≥ Minimum impulse noise protection for all bearer channels;
> - Delay ≤ Maximum delay for all bearer channels;
> - SNR Margin ≥ TARSNRM;
> - SNR Margin for the ROC ≥ TARSNRM.
>
> Within those constraints, the receiver shall select the values as to optimize in the priority given in one of the priority lists below, where the selection of the list is configured through the CO-MIB channel initialization policy parameter (CIPOLICY, see clause 7.3.2.10 of [ITU-T G.997.1]). The channel initialization policy applies only for the selection of the values exchanged during initialization and does not apply during SHOWTIME.
>
> Due to use of the specific modulation pattern of O/R-P-MEDLEY signal (modulation with SOC bytes followed by a quadrant scrambler), after the VTU enters the SHOWTIME state, the reported SNRM-ROC value can be inaccurate and lower than the TARSNRM value.
>
> If OLR type 3 (SRA) is supported and enabled, the VTU may initiate an SRA with vendor discretionary triggering criteria for a period of 10 seconds after the VTU has entered the SHOWTIME state in order to achieve a more accurate reported SNRM-ROC value greater than or equal to the TARSNRM value, preferably up to TARSNRM-ROC, as defined in the channel initialization policy below.

TQD-TX00355628 at TQD-TX00355922 (Rec. ITU-T G.993.2 (02/2019)).

> The following channel initialization policy is defined:
>
> - Policy ZERO if $CIpolicy_n$=0, then:
>   1) Maximize the SNR Margin for the ROC up to TARSNRM-ROC.
>   2) Maximize net data rate for all bearer channels, per the allocation of the net data rate, in excess of the sum of the minimum net data rates over all bearer channels (see clause 12.3.5).
>   3) Maximize the SNR Margin for the ROC above TARSNRM-ROC.
>   4) Minimize excess margin with respect to the maximum SNR margin MAXSNRM through gain adjustments (see clause 10.3.4.2). Other control parameters may be used to achieve this (e.g., MAXMASK, see clause 7.2.3).
>
> Support of channel initialization policy ZERO is mandatory. Additional channel initialization policies are for further study. The $CIpolicy_n$ parameter values other than 0 are reserved for use by the ITU-T.

TQD-TX00355628 at TQD-TX00355923 (Rec. ITU-T G.993.2 (02/2019)).

167. If the SNRMOFFSET-ROC value is set to zero such that the margins of the two latency paths are equal, then the first SNR margin is not different than the second SNR margin.

168. Claim 10.g "and wherein the first SNR margin provides more robust reception than the second SNR margin" is not met for the same reasons as claim 10.f. Since the margins on the

two latency paths are equal, the first SNR margin would also not be "more robust" than the second SNR margin as required by claim 10.g.

169. Moreover, in Dr. Cooklev's analysis, he did not consider several different conditional factors and the ability of the code to actually execute code that sends messages. *See generally*, Overby Rpt. [redacted]

2. Standard Compliance Does Not Necessitate Infringement.

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171. Claim 10 of the '354 Patent is not essential to G.993.2 (VDSL2) standard or to G.998.4 (G.inp). G.inp is an optional enhancement (not essential for practicing) for VDSL2 and is not a standalone standard. *See* COMMSCOPE124393-COMMSCOPE124518 (Rec. ITU-T G.998.4 (11/2018)). It is my understanding that it is not sufficient to establish infringement by arguing that the device practices the standard if the relevant section of the standard is optional.

172. In my experience, a product that operates in accordance with, is compliant with, or supports a particular standard does not necessarily implement each of the many hundreds of purportedly mandatory or optional sections of that particular standard exactly as they are specified.